TONER SUPPLY CONTAINER AND STIRRING ROTATION MEMBER

FIELD OF THE INVENTION AND RELATED ART:

The present invention relates to a developer supply container for supporting developer to an image forming apparatus of an electrophotographic type or the like and a stirring member usable therewith, more particularly to a developer supply container for supplying a developer to an image forming apparatus such as a copying machine, a printer, a facsimile machine or the like, and a stirring member usable therewith.

In a conventional image forming apparatus such as a copying machine and a printer of an electrostatic type or an electrophotographic type, fine particle toner is used as a developer. When the toner in the main assembly of image forming apparatus is consumed, the toner is supplied into the main assembly of image forming apparatus using a toner supply container.

Generally, the toner supply container comprises a main container body of a cylindrical or rectangular parallelopiped shape, made of synthetic resin material or the like, a sealing member for sealing an opening for supplying the toner from the main body on the container into the developing device,

a stirring rotation member and a feeding member for stirring and feeding the toner from the inner portion toward the opening of the container. A process cartridge is used in which the toner supply container is integral with a photosensitive drum, a cleaner, a charger and the like, the process cartridge being situated in the main assembly of the image forming apparatus in use.

Since the toner are very fine particles, that is a problem that toner is scattered during the toner supplying operation, with a result of contamination of the operator or the surroundings of the container. In consideration of this problem, there has been proposed a system in which the toner supply container is situated in the image forming apparatus similarly to the process cartridge, and the toner is discharged through the opening thereof.

Such a stationary type toner supply container may be provided with a stirring rotation member to prevent caking of the toner and to deliver the toner. The stirring rotation member is driven or rotated through engagement between a main assembly side driver through a coupling member extended out of an end of the toner supply container or by direct engagement.

In such a toner supply container provided with a stirring rotation member, if a rotational stirring torque is large, a relatively expensive high-

power electric motor is required, and it is necessary to raise the strength of the stirring rotation member.

Accordingly, various proposals have been made to reduce the rotational stirring torque. For example, Japanese Laid-open Patent Application Hei 8-272200 discloses a system in which a stirring rod of the stirring rotation member is rotatably supported by a spring, and when a load exceeding the elastic force of the spring acts on the stirring rod, the stirring rod flexes, by which the radius of rotation is shortened, and therefore, the rotational stirring torque is decreased. Japanese Laid-open Patent Application Hei 9-062072 discloses a system in which the rotational stirring torque is decreased by disposing three or more stirring blades of the stirring rotation member are disposed at the different angular positions.

However, such conventional systems involved the following problems. When the spring is used as with Japanese Laid-open Patent Application Hei 8-272200, the number of parts and number of assembling steps increase with the result of cost increase. When three or more stirring employees are disposed at different angular positions, the moldability and the assembling easiness property of the stirring blades are not good.

Therefore, there is a demand for a stirring

rotation member in which the number of parts is a small, the moldability and the assembling easiness property are good, and the rotational stirring torque is small.

It is pointed out that if the strength of the stirring rotation member is made lower, the rotational stirring torque decreases because of the increased twisting flexibility of the rotational stirring blade, but the stirring effects also decreases with the result of remarkable increase of the bulk density after transportation of the toner supply container. It is desired that toner can be stably stirred with stability even in such a case.

SUMMARY OF THE INVENTION:

Accordingly, it is a principal officer of the present intention to provide a developer supply container with which the stirring torque can be reduced without deteriorating the strength of the stirring member. Accordingly, it is a principal object of the present invention to provide a stirring member with which the stirring torque can be reduced without deteriorating the strength of the stirring member.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following

description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 is a sectional view of an electrophotographic copying machine which is an example of an electrophotographic image forming apparatus into which a toner supply container according to the present invention is mounted.

Figure 2 is a perspective view of an electrophotographic copying machine.

Figure 3 is a perspective view illustrating mounting of the toner supply container into the electrophotographic copying machine with an exchange cover of the electrophotographic copying machine in an open position.

Figure 4 is a perspective view of a toner supply container according to a first Embodiment 1 of the present invention as seen from the side provided with a supply opening (a) and a perspective view of the same as seen from the side provided with a grip (b).

Figure 5 is a front sectional view of a toner supply container according to Embodiment 1 of the present invention.

Figure 6 is a perspective view of a toner

supply container according to a first Embodiment 1 of the present invention as seen from the side provided with a supply opening (a) and a perspective view of the same as seen from the side provided with a grip (b).

Figure 7 is a front view of a toner supply container according to Embodiment 1 of the present invention (a), a sectional view of the same (b), a left side view (c), a right side view (d), a sectional side view (e), and a top plan view (f).

Figure 8 is a front view (a) of a sealing member, a view (b) of the same as seen in a direction An in (a), a view (c) of the same in a direction B in (a), and a front sectional view (d) of the same.

Figure 9 is a front view (a) of a stirring rotation member according to Embodiment 1 of the present invention, a top plan view (b) of the same, a side view (c) of the same, a top plan view (d) of a horizontal portion of the same, and a side view (e) of a supporting arm of the same.

Figure 10 is a front sectional view of a toner supply container provided with a stirring rotation member according to Embodiment 1 of the present invention.

Figure 11 is a front view (a) of a stirring rotation member according to Embodiment 2 of the present invention, a top plan view (b) of the same, a

side view (c) of the same, a top plan view (d) of a horizontal portion of the same, and a side view (e) of a supporting arm of the same.

Figure 12 is a front sectional view of a toner supply container provided with a stirring rotation member according to Embodiment 1 of the present invention.

Figure 13 is a front view (a) of a stirring rotation member according to Embodiment 3 of the present invention, a top plan view (b) of the same, a side view (c) of the same and a top plan view (d) of a horizontal portion of the same.

Figure 14 is a front sectional view of a toner supply container provided with a stirring rotation member according to Embodiment 1 of the present invention.

Figure 15 is a front view (a) of a stirring rotation member in which L1=L3= is approx. 10mm, a top plan view (b) of the same, a side view (c)of the same, and a side view (e) of a supporting arm.

Figure 16 illustrates a mechanism by which the rotational stirring torque of the stirring rotation member having dimensions of L1= approx. 10mm, L3= approx. 6mm and L2= 15mm decreases as compared with a stirring rotation member having dimensions of L1=L3= approx. 10mm and L2= 15mm.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

<Embodiment 1>

Referring to Figure 1, the description will first be made as to an electrophotographic copying machine which is an example of an electrophotographic image forming apparatus to which a toner supply container according to an embodiment of the present invention is mounted.

Figure 1 is a sectional view of an electrophotographic copying machine, in which reference numeral 100 designates a main assembly of the electrophotographic copying machine which will be called hereinafter "main assembly of the apparatus", 101 is an original document, which is placed on an original supporting platen glass 102. A light image is formed on an electrophotographic photosensitive drum 104 in accordance with image information by a plurality of mirrors M and a lens Ln of an optical portion 103, and an electrostatic latent image is formed on the photosensitive drum 104.

Designated by 105-108 are cassettes, one of which is selected, depending on sheet size information of the cassettes 105-108, on the basis of information inputted by the operator on an operating portion 100a (Figure 2) or automatically on the basis of the paper size of the original 101, to feed the selected or proper recording material P out. Here, the recording

material is not limited to paper but may be an OHP sheet.

The sheet P is singled out and is fed to registration rollers 110: a feeding portion 109 by a sheet feeding and separating devices 105A-108A so as to feed the sheet P in synchronism with the rotation of the photosensitive drum 104 and the scanning timing of the optical portion 103. Designated by 111 is a transfer discharger, and 112 is a separation discharger. The toner image formed on the photosensitive drum 104 is transferred onto the sheet P by a transfer discharger 111.

The sheet P on which the toner image has been transferred, is separated from the photosensitive drum 104 by a separation discharger 112.

The sheet P is fed by a feeding portion 113 to an image fixing portion 114, in which the toner image is fixed on the sheet P by heat and pressure. When one sided copy mode is selected, the sheet passes through a sheet discharge reversion portion 115 and is discharged onto a sheet discharge tray 117 by sheet discharging rollers 116. If a duplex copy is selected, the sheet is refed to the registration rollers 110 through a refeeding passage 119 and 120 under the control of a flapper 118 at a sheet discharge reversion portion 115.

When a superimposed copy mode is selected, a

part of the sheet P is temporarily discharged to an outside of apparatus by the sheet discharging rollers 116 through the sheet discharge reversion portion 115. Thereafter, at the time when the trailing end of the sheet P has passed through the flapper 118 and is still nipped by the sheet discharging rollers 116, the flapper 118 is controlled, and the sheet discharging rollers 116 are rotated in the opposite direction to refeed the sheet P into the main assembly 100 of the apparatus. Thereafter, the sheet P is fed to the registration rollers 110 through the sheet refeeding portion 119, 120, and then fed in the same manner as with the one-sided copy mode onto the sheet discharge tray 117.

In the main assembly 100 of the apparatus having such structures, there are a developing station 201, a cleaning station 202 and a primary charger 203 and the like around the photosensitive drum 104. The developing station 201 functions to develop the electrostatic latent image formed on the photosensitive drum 104 in accordance with the information of the original 101 by the optical portion 103, with toner. A toner supply container 301 for supplying the toner to the developing station 201 is provided in the main assembly 100 of apparatus, the toner supply container 301 being detachably mountable by the user. The developing station 201 includes a

toner hopper 201a and a developing device 201b.

The toner hopper 201a is provided with a stirring member 201c for stirring the toner supplied from the toner supply container 301, and the toner stirred by the stirring member 201c is fed to the developing device 201b by a magnet roller 201d. The developing device 201b includes a developing roller 201f and a feeding member 201e. The toner fed from the toner hopper 201a by the magnet roller 201d is fed to the developing roller 201f by the feeding member 201e, and is supplied to the photosensitive drum 104 by the developing roller 201f.

The cleaning station 202 functions to remove the toner remaining on the photosensitive drum 104, and primary charger 203 functions to electrically charge the photosensitive drum 104.

When the user opens, as shown in Figure 3, the toner supply container exchange cover 15 which is a part of the outer casing as shown in Figure 2, a container supporting tray 50 is drawn out to a predetermined position by an unshown driving system. Then, the toner supply container 301 is placed on the tray 50. When the user removes the toner supply container 301 from the main assembly of apparatus, the toner supply container 301 on the open tray 50 is taken out. The cover 15 is opened and closed only for the purpose of mounting and demounting of the toner

supply container 301. In the case of the maintenance operation, the front cover 100c is opened.

The toner supply container 301 may be directly set into the main assembly 100 of the apparatus, or may be directly taken out of the main assembly 100 of the apparatus.

(General arrangement of toner supply container)

The description will be made as to the toner supply container 301 according to this embodiment of the present invention.

Figure 4 is a perspective view of a toner supply container 301 according to an embodiment of the present invention, and Figure 5 is a front sectional view of a toner supply container 301.

In Figures 4 and 5, designated by 301A is a main body of the container, 302 is a feeding member for feeding the toner toward a toner supply opening 301a, and 303 is a sealing member for sealing the toner supply opening. Reference numeral 305 designates a stirring member for stirring the toner in the main body 301A of the container; 306 is a coupling member for transmitting a rotational driving force to the stirring member 305 from the image forming apparatus through engagement with the stirring member 305; 309 is an oil seal for preventing toner leakage.

Referring to Figures 6 and 7, the main body 301A of the toner supply container will be described.

Figure 6 is a perspective view of a main body 301A of the container; Figure 7 is a front view of a main body 301A of the container (a), a sectional view thereof (b), a left-hand side view (c), a right-hand side view (d), and a sectional side elevation (e).

The main body 301A of the toner supply container comprises a curved portion 301F having a width which decreases toward the bottom, a linear portion 301G having a substantially constant width provided at the bottom of the curved portion 301F, and a substantially semicircle portion 301H provided at the bottom of the linear portion 301G.

It is preferable that main body 301A of the container is produced through an injection molding, a blow molding and an injection blow molding or the like from a plastic resin material resin material or the like, but may be produced from another material through another method. It is preferable that main body 301A of the container is divided into two or more parts, which are united by welding, bonding or the like.

The lower portion of a side surface 301A1 of the main body 301A of the container is provided with a cylindrical toner supply opening 301a, projected therefrom, for supply the toner from the toner accommodating portion 301n into the main assembly 100 of the apparatus. One end portion of the toner supply

opening 301a is provided with a toner supply opening 301g. The other side surface 301B of the main body 301A of the container is provided with a first receiving portion 301b1 for rotatably supporting a feeding member 302 at a position corresponding to the toner supply opening 301a. The outside of the bottom surface 301D is provided with a positioning portion 301c which is to be positioned by the main assembly 100 of the apparatus when the toner supply container 301 is mounted to the main assembly 100 of the apparatus. The positioning portion 301c is engaged with an opening and closing means for the toner supply opening provided in the main assembly 100 of the apparatus to move the toner supply container 301 in the mounting-and-demounting direction. In this embodiment, the engaging portion 301c is in the form of a dowel projected outwardly from the lower surface 301D.

The upper surface 301E of the main body 301A of the container is provided with grip 301e which is gripped by the user when the toner supply container 301 is mounted to or demounted from the main assembly 100 of the apparatus. A lower inclined surface (curved portion) at each of the front side and rear surface is provided with a groove 301f extended substantially parallel with the longitudinal direction of the toner supply container 301 to facilitate

handling of the main body 301A of the container when the toner supply container 301 is mounted to the main assembly 100 of the apparatus.

Above a first receiving portion 301b1 of the other side surface 301B of the main body 301A of the container, there is provided a second receiving portion 301b2 for rotatably supporting the stirring member 305.

The toner supply opening 301a is disposed in a side surface 301A1 which is opposite from the side surface 301B provided with the grip 301e with respect to the longitudinal direction of the main body 301A of the container. Therefore, the user is prevented from contacting unintentionally the toner supply opening 301a when the toner supply container 301 is mounted to the main assembly 100 of the apparatus. The toner supply opening 301a is provided at a lower portion of the side surface 301A1, therefore, the toner can be efficiently delivered even when the common of the toner remaining in the main body 301A of the container becomes small.

Here, the toner supply opening 301a is cylindrical, and height thereof is 27.8mm, and an outer diameter of the cylindrical portion thereof is approx. 27.6mm, in this embodiment.

The outside of the lower surface 301D of the main body 301A of the container is provided with an

engaging portion 301c which is correctly position by a locking portion provided in the main assembly 100 of the apparatus when the toner supply container 301 is mounted to the main assembly 100 of the apparatus. The engaging portion 301c is in the form of a projection of circular column shape projected outwardly from the lower surface 301D as described hereinbefore, and an outer diameter of the circular column shape portion is approx. 8mm in this embodiment.

The engaging portion 301c functioning as the positioning portion is disposed at a position 2mm -8mm from the lower surface 301D and approx. 71mm from a side end surface 301B opposite from the side having to toner supply opening 301a with respect to the longitudinal direction of the lower surface 301D.

The engaging portion (positioning portion) 301c has a preferably a circular column shape, but it may be of a prism shape, a semicircular or the like. On the side surface 301A1 and the other side surface 301B are each provided with two bosses 301k, 3011 and boss 301k, 3011 for positioning the main body 301A of the container when the dimensional inspection is carried out for the main body 301A of the container before factory shipment.

Designated by 301m is a rib for preventing erroneous mounting prevention. The rib 301m position

is different if the toner supply container 301 is different, so that user is prevented from erroneously mounting different types of containers into the main assembly 100 of the apparatus.

It is preferable that main body 301A of the container is produced through an injection molding, a blow molding and an injection blow molding or the like from a plastic resin material resin material or the like, but may be produced from another material through another method. It is preferable that main body 301A of the container is divided into two or more parts, which are united by welding, bonding or the like.

In this embodiment, two frames, namely, an injection molded upper frame and an injection molding lower frame of high impact polystyrene are welded with each other through vibration welding.

As shown in Figure 5, the feeding member 302 comprises a shaft portion 302A and a feeding blade 302B provided on the shaft portion 302A. The feeding blade 302B functions as a feeding portion for feeding the powdery toner in the predetermined direction by rotation of the shaft portion 302A. It includes a high rigidity helical blades. The feeding member 302 is mounted to the main body 301A of the container such that axis of the shaft portion 302A is substantially aligned with the center of the substantially circular

toner supply opening 301g.

The feeding member 302 is not limited to that of a so-called screw type described in this embodiment, but may be another type, for example, it may comprises a shaft portion 302A and a flexible blade. The shaft portion 302A and the feeding blade 302B may be integrally molded, or they may be separate members. In this embodiment, the shaft portion 302A and the feeding blade 302B are an integrally molded plastic resin.

The feeding member 302 is provided with an extended portion 302C inside the cylindrical portion of the toner supply opening 301a. In this embodiment, the extended portion 302C is protected out of the toner supply opening 301a, and a free end portion of the outward extended portion of the extended portion 302C functions to receive a rotational driving force from the main assembly 100 of the apparatus. For this reason, a sealing member 303 which is movable in the axial direction is mounted at the free end portion of the feeding member 302.

An end portion (driving force receiving portion) of the extended portion 302C of the feeding member 302 has such a configuration (polygonal shape, more particularly rectangular configuration) suitable for receiving the rotational driving force from the main assembly 100 of apparatus through a sealing

member 303.

One end portion of the shaft portion 302A is supported to the sealing member 303 through one end portion 302a of the extended portion 302C. The other end portion 302b of the shaft portion 302A is rotatably supported by a first bearing member 308, so that when the main body 301A of the container is unsealed or opened, the shaft portion 302A is rotatably supported by the first bearing member 308.

The feeding member 302 is supported by a sealing member 303 without contact to an inner wall surface of the toner supply opening 301a and that shaft portion 302A is substantially horizontal with the inner wall surface of the toner supply opening 301a. By supporting the feeding member 302 in this manner, the toner can be fed substantially in a horizontal direction toward the toner supply opening when the feeding member 302 is rotated.

Referring to Figure 8, the description will be made as to the sealing member 303. Figure 8 is a front view of the sealing member 303 thereof (a), a view thereof as seen in a direction A (b), a view thereof as seen in a direction B, and a front sectional view thereof (d).

In Figure 8, designated by 303b is a sealing portion which unsealably seals the toner supply opening 301g of the toner supply container 301, and is

provided at a side of the sealing member 303 opposed to the toner supply container 301. The sealing portion 303b has an outer diameter which is larger than an inner diameter of the 301g by a proper degree. An engaging portion 303b1 of the sealing portion 303b is press-fitted into the toner supply opening 301a through the toner supply opening 301g, so that sealing member 303 seals the toner supply opening 301g.

Designated by 303c is a coupling engaging portion functioning as a driving force receiving portion (driver) for receiving a driving force for rotating the feeding member 302 from the main assembly 100 of the apparatus when the toner supply container 301 is mounted to the main assembly 100 of the apparatus. The coupling engaging portion 303c is provided with a projected portion 303c1 extended from the sealing portion 303b substantially coaxially with the shaft portion 302A of the feeding member 302 away from the main body 301A of the toner container when the sealing member 303 is mounted to the main body 301A of the container. The coupling engaging portion 303c is provided on the peripheral surface of the projected portion 303c1, and is provided with an elongated projection (rib) 303d (in the form of a spline) which functions as a driving force receiving portion engageable with the coupling member 306. In this embodiment, spline projection 303d is provided at

each of two equidistant positions. More particularly, they are at diametrically opposite positions (approximately 180^{o} away from each other). The rib 303d is approx. 1.8mm away from the outer periphery of the sealing member 303, and the projected portion 303c1 has an outer diameter of approx. 12mm.

The sealing member 303 is provided with an engaging hole 303a functioning as a driving force transmitting portion for transmitting to the feeding member 302 the driving force received from the main assembly 100 of the apparatus for engagement with the one end portion 302a of the feeding member 302. The engaging hole 303a is in the form of an opening (hollow portion) formed through the sealing portion 303b and the coupling engaging portion 303c. The engaging hole 303a has a rectangular cross-section corresponding to the rectangular configuration of the end 302a of the shaft of the feeding member 302 projected through the toner supply opening 301a, and is slightly larger than the end 302a of the shaft, so that end 302a is loosely fitted with the engaging hole 303a.

By the loose fitting of the shaft end 302a with the engaging hole 303a, the relative axial movement between the feeding member 302 and the sealing member 303 is permitted while relative rotation therebetween is prevented. By doing so, the

sealing member 303 is separable from the main body 301A of the container, and therefore, the toner supply opening 301g can be unsealed (opened) upon the mounting of the toner supply container 301.

The length through which the engaging hole 303a and the shaft end 302a are engaged with each other, is enough such that engagement therebetween is maintained when the sealing member 303 is moved apart from the main body 301A of the container. Therefore, even if the sealing member 303 is separated from the main body 301A of the container, the feeding member 302 can receive the driving force through the sealing member 303 (coupling engaging portion 303c).

In addition, between the coupling engaging portion 303c and sealing portion 303b, there is provided a flange portion 303f which is abutted to an end of the toner supply opening 301a when the sealing portion 303b is press-fitted into the toner supply opening 301a. The flange portion 303f has an outer diameter which is substantially the same as the outer diameter of the toner supply opening 301a (preferably, smaller than the outer diameter of the toner supply opening 301a), and therefore, the sealing portion 303b is press-fitted into the toner supply opening 301a by the flange portion 303f by the amount corresponding to the length of the sealing portion 303b.

On the other hand, designated by 303e is a

locking projection which is formed at a free end of the coupling engaging portion 303c and which constitutes a locking portion engageable with a locking member provided in the main assembly 100 of apparatus. By engagement of the locking member of the main assembly side with the locking projection 303e, the sealing member 303 can be fixed when the toner supply opening 301g is opened.

It is preferable that sealing member 303 of such a structure is manufactured through injection molding of plastic resin material or like, but another material and manufacturing method are usable. For example, a plurality of members are connected. Since the sealing member 303 is press-fitted into the toner supply portion 301a, it is required to have a proper elasticity. The best material is low density polyethylene, and another preferable material next to the low density polyethylene includes polypropylene, Nylon, high density polyethylene and the like.

Designated by 303j is a locking groove engageable with a locking member provided in the main assembly 100 of apparatus.

As described in the foregoing, the sealing member 303 includes a substantially cylindrical engaging portion 303b1 engageable with the toner supply opening 301a and a flange portion 303f disposed substantially coaxially with the engaging portion

303b1. It further comprises a projected portion 303c1 substantially coaxially with the engaging portion 303b1 at a position across the flange portion 303f from the engaging portion 303b1, and the base portion thereof has a driving receiving portion 303d.

The leading end portion of the projected portion 303c1 with respect to the projecting direction is provided with a locking groove 303j and a locking projection 303e. A hollow portion extends from the engaging portion 303b1 side toward the locking projection 303e, and a driving force transmitting portion is provided in the hollow portion. The locking projection 303e side of the hollow portion is not open, and therefore, the toner having entered the hollow portion does not leak to the outside of the toner supply container 301 when the engaging portion 303b1 is engaged with the toner supply opening 301a. Accordingly, the toner supply opening 301a is sealed by mounting the sealing member 303.

Thus, the sealing member 303 performs the following four functions:

(1) sealing the toner supply opening 301a;

(2) receiving the rotational driving force from the main assembly 100 of the apparatus;

(3) transmitting the rotational driving force to the feeding member 302; and

(4) engaging with the engageable member provided in

the main assembly 100 of the apparatus for opening and closing the toner supply opening 301a.

Thus, the sealing member 303 is capable of transmitting the driving force from the main assembly 100 of the apparatus through the extended portion 302C to the shaft portion 302A to rotate the feeding member 302.

Referring to Figures 9 and 10, the description will be made as to the stirring rotation member 305 for stirring toner by its rotation. Figure 9 is a front view of the stirring rotation member 305 (a), and a top plan view thereof (b), a side view thereof (c), a top plan view of a horizontal portion 305c2 (d), side views of supporting arms 305b2, 305b5 (e); and Figure 10 is a front sectional view of a toner supply container 301 provided with a stirring rotation member 305.

As shown in Figure 10, the stirring rotation member 305 includes a rotation shaft portion 305a (stirring shaft), supporting arms 305b (connecting portion), bridging portions 305c (supporting portion) and flexible members 313 which flexes during the stirring operation inwardly toward downstream. The rotation shaft portion 305a, the supporting arms 305b and the bridging portion 305c are produced through injection molding from a plastic resin material having a relatively high rigidity, whereas the flexible

member 313 has a relatively low rigidity material (for example, plastic resin material film or sheet, an elastomer sheet or the like). In this embodiment, the flexible member 313 is made of a polyester sheet.

It is preferable that rotation shaft portion 305a, the supporting arms 305b and the bridging portion 305c are preferably produced integrally from a relatively high rigidity plastic resin material through an injection molding, but may be produced by connecting a plurality of parts by welding, bonding or the like into an integral member.

In the embodiment, the use is made with an ABS resin material which is integrally molded through an injection molding.

The description will be made as to the configurations of the rotation shaft portion 305a, the supporting arm 305b and the bridging portion 305c according to one of the features of the present invention.

The rotation shaft portion 305a and the rotation shaft portion 305a are each in the form of a rod having a diameter of 9mm, and one end 305d of the rotation shaft portion 305a is engageable with the coupling member 306. The other end 305e is engageable with a stopper member (second bearing member) in the second receiving portion 301b2 of the main body 301A of the toner supply container. The coupling member

306 and the stopper member are rotatably supported on the main body 301A of the container through the bearing member 308. Six supporting arms 305b (305b1-305b6) are extended substantially perpendicularly from the rotation shaft portion 305a, and proper roundings are provided at the connecting portions between the rotation shaft portion 305a and the supporting arms 305b to enhance the strength of the stirring rotation member 305, in view of a possibility that toner is caked with the result of increased stirring resistance. In this embodiment, R2 is provided at each of the connecting portions between the rotation shaft portion 305a and the supporting arms 305b.

The supporting arm 305b and the supporting arm 305b are each in the form of a flat plate and are extended substantially perpendicularly from the rotation shaft portion 305a, and in this embodiment, it has a width 305bL5 (Figure 9) of approx. 12mm and a height of approx. 39.4mm from the axis of the shaft portion 305a. Such supporting arms 305b (305b1-305b6) are provided at six positions, respectively. The thickness 305bL4 (Figure 9) of the supporting arm 305b is preferably 1mm -3mm, and is approx. 2mm. Such supporting arms 305b are provided at six positions, respectively. More particularly, in addition to two supporting arms 305b1, 305b3 and 305b4, 305b6 supporting the opposite axial end portions of the

horizontal portion 305c2 (crossing portion), there are provided supporting arms 305b2, 305b5 supporting the horizontal portion 305c2 at substantially central portions with respect to the axial direction. Connecting portions between the supporting arms 305b2, 305b5 and the bridging portion 305c have narrowed free ends so as to meet a length L1 of the horizontal portion 305c2 of the bridging portion 305c. A distance between the center of the rotation shaft portion 305a and the free end of the supporting arm 305b is properly determined in accordance with the size of the main body 301A of the container, but generally it is preferably 70% - 95% of an inner radius of the main body 301A of the container. In this embodiment, the inner diameter of the main body 301A of the container is approx. 44.5mm, and the length is approx. 39.4mm (89%).

The bridging portion 305c and the bridging portion 305c are constituted by two portions and are staggeredly arranged to provide a phase difference of approx. 180^{o} substantially at the central portion with respect to the axial direction. Total lengths of the bridging portions 305c measured in the axial direction are approx. 180mm, and the bridging portions 305c are spaced apart from the rotation shaft portion 305a by 39.4mm correspondingly to the height of the supporting arm 305b. The bridging portion 305c includes a

horizontal portion 305c2 extending substantially parallel with a moving direction of the stirring rotation member 305 and an inclined surface portion 305c1 provided downstream of the bridging portion 305c.

The inclined surface portion 305c1 and inclined surface portion 305c1 are provided downstream of the bridging portion 305c with respect to the rotational direction. The inclined surface portion 305c1 is provided with eight projection integral with each of the inclined surface portion 305c1 to securedly support the flexible member 313. The inclined surface portion 305c1 has such a configuration such that width of the inclined surface portion 305c1 at the position where the projections are provided and that at the position where the projections are provided are different from each other, more particularly, the former is larger. In this embodiment, the larger one is approx. 8mm, and the shorter one is approx. 5mm. An angle θ of the inclined surface portion 305c1 relative to the moving direction of the bridging portion 305c (an angle formed between a direction α of overhanging extension of the flexible member and a tangential direction β indicated in Figure 9, (c)) is preferably 30^{o} - 60^{o}, and in this embodiment, $\theta=45^{o}$ (Figure 9). In the toner supply container 301 in this embodiment, the

rubbing force with which the inner wall surface of the container accommodating portion is too small if the angle θ is smaller than 30^{o} with the result of increase of the remaining toner amount, and if the angle θ is larger than 60^{o}, the rubbing force is too strong with the result of increased stress applied to the toner, which leads to production of large particles of the toner, and therefore, to increase of the stirring torque.

The horizontal portion 305c2 and the horizontal portion 305c2 are integral to each other and are provided upstream of the bridging portion 305c with respect to the rotational direction, extending substantially parallel with the moving direction. In this embodiment, the length of the horizontal portion 305c2 (bridging portion 305c), measured in the moving direction (tangential direction of the circumferential movement, upward in Figure 9, (d)) of the horizontal portion 305c2 adjacent the connecting portion between the bridging portion 305c and the supporting arm 305b, at each of the opposite longitudinal end portion of the bridging portion 305c, is L3, and the length measured in the same direction at a position away from said connecting portion is L1. More particularly, L1 is the length between the central line extending left-right direction and the bottom line in Figure 9, (d), as shown in this Figure, and L3 is the length measured

in the same direction at the left and right end positions. In this embodiment, L3 is approx. 10mm, L1 is approx. 6mm. The horizontal portion 305c2 is connected with the supporting arms 305b2, 305b5 at the central portion with respect to the axial direction, but the lengths are rather arbitrary, and the lengths in the widthwise direction may be L1 or L3.

The foregoing embodiment is summarized as follows:

(1) when the flexible member is not flexed, the bridging portion has an inclined surface portion which is contacted to the flexible member and which is parallel with the direction of overhanging extension of the flexible member, and has a horizontal portion (substantially circumferentially extending portion) extending in a direction crossing with the overhanging direction.

(2) on the other hand, when the flexible member flexes inwardly toward the downstream direction (when the flexible member is bent to the maximum extent without existence of the toner between the bridging portion and the flexible member), the bridging portion has a contact portion (above the supporting arm with respect to a direction indicated by "gamma" (along the axix of the shaft)) which is contacted to the flexible member, and a non-contact portion (adjacent the contact portion) which is not

contacted with the flexible member. By this, the strength of the rotational stirring member is assured by not deteriorating the strength of the connecting portion relative to the supporting arm, thus avoiding damage of the connecting portion between the bridging portion and the supporting arm. In addition, the horizontal portion has a portion in the form of a cut-away portion between the supporting arms, thus minimizing the accumulation or agglomeration of the toner sandwiched between the flexible member and the horizontal portion, and therefore, decreasing the stirring torque.

Accordingly, the strength of the rotational stirring member is assured so as to endure the stirring resistance, and simultaneously, the stirring torque required to rotate the stirring member is decreased.

For example, from the standpoint of enhancing the strength, it is preferably L3 (10mm), and from the standpoint of decreasing the torque, it is preferably L1 (6mm). In this embodiment, the length of the connecting portion substantially at the central portion of the horizontal portion 305c2, measured along the short side, is 6mm which is the same as the length L1.

The description will be made as to the flexible member 313.

The flexible member 313 is made of a material having a low rigidity, for example, PET (polyethylene terephthalate), PE (polyethylene), PP (polypropylene), PPS (polyphenylenesulfide resin material) sheet or the like. The thickness of the flexible member 313 is preferably approx. 50μm -500μm -500μm, and further preferably 100μm -300μm. In this embodiment, the flexible member 313 is a polyester sheet having a thickness of approx. 100μm.

In this embodiment, the flexible member 313 has a length which is larger than the distance from a free end of the rigid member blade portion to the inner wall surface of the container with respect to the circumference wall surface substantially parallel with the rotational axis. A length of a free end from the end of the inclined surface portion 305c1 is L2 which is 15mm in this embodiment.

In this embodiment, all of the flexible members 313 are fixed on the inclined surface portion 305c1 by one crimping action. Other fixing method is usable, such as rivetting, double coated tape or the like, or it may be integrally molded with the bridging portion 305c. Toner discharging test has been carried out with the toner supply container 301 having the above-described structures. The toner discharging test was carried out, 1650g of toner (one component black toner which has positive charging property and

which is for GP605 process cartridge available from Canon Kabushiki Kaisha had been filled into the container, and the container had been subjected to a tapping process using a tapping machine.

The results of the test has shown that rotational stirring torque required for the stirring rotation at the initial stage is reduced by approx. 20% as compared with a toner supply container not using the present invention, that is, as compared with the container in which the length measured in the tangential direction of the motion of the horizontal portion 305c2 is constant (approx. 10mm) in the longitudinal direction thereof, under the common conditions in which L1=L3= approx. 10mm L2= 15mm at the horizontal portion 305c2 of the bridging portion 305c.

Figure 15 shows a stirring rotation member 305 having lengths L1=L2= approx. 10mm and L 3= 15mm. Figure 15 is a front view of the stirring rotation member 305 (a), a top plan view thereof (b), a side view thereof (c), a top plan view of a horizontal portion 305c2, a side view of supporting arms 305b2, 305b5 disposed at the central portion of the bridging portion 305c.

As regards the blade strength, the rotational stirring blade having lengths L1=L3= approx. 10mm is durable against the rotational stirring torque of 35-

40 kgf.cm without damage or blanching, and the rotational stirring blade having the structure of this embodiment having the lengths L1= approx. 10mm and L3= approx. 6mm is durable against the rotational stirring torque of 35-40 kgf.cm without damage or blanching.

Referring to Figure 16, the description will be made as to a mechanism for reduction of the rotational stirring torque.

As shown in Figure 16, (a), when L1= L3= 10mm and L2= 15mm, the situation is like this. Even when the stirring rotation of the stirring rotation member 305 begins, an agglomeration of the toner accumulated behind the flexible member 313 is kept accumulated, and therefore, the flexible member 313 is unable to or hardly flex. On the other hand, in the case of Figure 18 (b), in which L 1= 6mm, L 3= 10mm and L 2= 15mm, when the stirring rotation of the stirring rotation member 305 begins, an agglomeration of the toner accumulated behind the flexible member 313 disappears, and therefore, the flexible member 313 is able to flex. As a result, the projected area of the stirring rotation member 305 relatively to the toner decreases, and therefore, the rotational stirring torque can be reduced.

<Embodiment 2>

The description will be made as to Embodiment 2 of the present invention. Since the structures of

this embodiment are the same as with Embodiment 1, the detailed description will be made as to the configurations of the rotation shaft portion 325a, the supporting arm 325b and the bridging portion 325c of the stirring rotation member 325.

Figure 11 is a front view of the stirring rotation member 325 (a), a top plan view thereof (b), a side view thereof (c), a top plan view of the horizontal portion 325c2 (d), a side view of the supporting arms 325b2, 325b5 and supporting arm 325b2, 325b5 (e); and Figure 12 is a sectional front view of a toner supply container 301 provided with the stirring rotation member 325.

As shown in Figure 12, the stirring rotation member 325 includes a rotation shaft portion 325a, supporting arms 325b, bridging portions 325c and flexible members 313. The rotation shaft portion 325a, the supporting arms 325b and the bridging portion 325c are produced through injection molding from a plastic resin material having a relatively high rigidity, whereas the flexible member 313 has a relatively low rigidity material (for example, plastic resin material film or sheet, an elastomer sheet or the like). In this embodiment, the flexible member 313 is made of a polyester sheet.

It is preferable that rotation shaft portion 325a, the supporting arms 325b and the bridging

portion 325c are preferably produced integrally from a relatively high rigidity plastic resin material through an injection molding, but may be produced by connecting a plurality of parts by welding, bonding or the like into an integral member. In the embodiment, the use is made with an ABS resin material which is integrally molded through an injection molding.

The description will be made as to the configurations of the rotation shaft portion 325a, the supporting arm 325b and the bridging portion 325c according to one of the features of the present invention.

The rotation shaft portion 325a and the rotation shaft portion 325a are each in the form of a rod having a diameter of 9mm, and one end 305d thereof is engageable with the coupling member 306. The other end 325e is engageable with a stopper member (second bearing member) in the second receiving portion 301b2 of the main body 301A of the toner supply container. The coupling member 306 and the stopper member are rotatably supported on the main body 301A of the container through the bearing member 308. Six supporting arms 305b (305b1-305b6) are extended substantially perpendicularly from the rotation shaft portion 305a, and proper roundings are provided at the connecting portions between the rotation shaft portion 305a and the supporting arms 305b to enhance the

strength of the stirring rotation member 305. In this embodiment, R2 is provided at each of the connecting portions between the rotation shaft portion 325a and the supporting arms 325b.

The supporting arm 325b and the supporting arm 325b are each in the form of a flat plate and are extended substantially perpendicularly from the rotation shaft portion 325a, and in this embodiment, it has a width 325bL5 (Figure 11) of approx. 12mm and a height of approx. 39.4mm from the axis of the shaft portion 325a. Such supporting arms 325b (325b1-325b6) are provided at six positions, respectively. The thickness 325bL4 (Figure 11) of the supporting arm 325b is preferably 1mm -3mm, and is approx. 2mm. Such supporting arms 325b (325b1-325b6) are provided at six positions, respectively. More particularly, in addition to two supporting arm 325b1, 325s b3 and 325b4, 325b6 supporting the opposite axial end portions of the horizontal portion 325c2, there are provided supporting arm 325b2, 325s b5 supporting the horizontal portion 325c2 at substantially central portions with respect to the axial direction. A distance between the center of the rotation shaft portion 325a and the free end of the supporting arm 325b is properly determined in accordance with the size of the main body 301A of the container, but generally it is preferably 70% - 95% of an inner

radius of the main body 301A of the container. In this embodiment, the inner diameter of the main body 301A of the container is approx. 44.5mm, and the length is approx. 39.4mm (89%).

The bridging portion 325c and the bridging portion 325c are constituted by two portions and are staggeredly arranged to provide a phase difference of approx. 180^{o} substantially at the central portion with respect to the axial direction. Total lengths of the bridging portion 325s c measured in the axial direction are approx. 180mm, and the bridging portion 325s c are spaced apart from the rotation shaft portion 325a by 39.4mm correspondingly to the height of the supporting arms 325b2 and 325b5. The bridging portion 325c includes a horizontal portion 325c2 extending substantially parallel with a moving direction of the stirring rotation member 325 and an inclined surface portion 325c1 provided downstream of the bridging portion 325c.

The inclined surface portion 325c1 and inclined surface portion 325c1 are provided downstream of the bridging portion 325c with respect to the rotational direction. The inclined surface portion 325c1 is provided with eight projection integral with each of the inclined surface portion 325c1 to securedly support the flexible member 313. The inclined surface portion 325c1 has such a

configuration such that width of the inclined surface portion 325c1 at the position where the projections are provided and that at the position where the projections are provided are different from each other, more particularly, the former is larger. In this embodiment, the larger one is approx. 8mm, and the shorter one is approx. 5mm. An angle θ of the inclined surface portion 325c1 relative to the moving direction of the bridging portion 325c is preferably 30^{o} - 60^{o}, and in this embodiment, $\theta=45^{o}$.

The horizontal portion 325c2 and the horizontal portion 325c2 are integral to each other and are provided upstream of the bridging portion 325c with respect to the rotational direction, extending substantially parallel with the moving direction. In this embodiment, the length of the horizontal portion 325c2 (bridging portion 325c), measured in the moving direction (tangential direction of the circumferential movement, upward in Figure 11, (d)) of the horizontal portion 325c2 adjacent the connecting portion between the bridging portion 325c and the supporting arm 325b, at each of the opposite longitudinal end portion of the bridging portion 325c, is L3, and the length measured in the same direction at a position away from said connecting portion is L1. More particularly, L1 is the length between the central line extending left-right direction and the bottom line in Figure 11, (d),

as shown in this Figure, and L3 is the length measured in the same direction at the left and right end positions. In this embodiment, L1 is approx. 6mm, L3 is approx. 10mm. The horizontal portion 325c2 is connected with the supporting arm 325b2, 325s b5 at the central portion with respect to the axial direction, but the lengths are rather arbitrary, and the lengths in the widthwise direction may be L1 or L2. In this embodiment, the length of the connecting portion substantially at the central portion of the horizontal portion 325c2, measured along the short side, is 10mm which is the same as the length L3.

The flexible member 313 is similar to that of Embodiment 1, and therefore, the detailed description thereof is omitted for simplicity. A length L2 of free portion of the flexible member 313 from the end of the inclined surface portion 325c1 is 15mm.

Toner discharging test has been carried out with the toner supply container 301 having the above-described structures. The toner discharging test was carried out, 1650g of toner (one component black toner which has positive charging property and which is for GP605 process cartridge available from Canon Kabushiki Kaisha had been filled into the container, and the container had been subjected to a tapping process using a tapping machine.

The results of the toner discharging test has

shown that rotational stirring torque required for the stirring rotation at the initial stage is reduced by approx. 20% as compared with a toner supply container not using the present invention, that is, as compared with the container in which the length measured in the tangential direction of the motion of the horizontal portion 305c2 is constant (approx. 10mm) in the longitudinal direction thereof, under the common conditions in which L1=L3= approx. 10mm and L2= 15mm at the horizontal portion 305c2 of the bridging portion 305c.

As regards the blade strength, the rotational stirring blade having lengths L1=L3= approx. 10mm and L2= approx. 15mm is durable against the rotational stirring torque of 35-40 kgf.cm without damage or blanching, and the rotational stirring blade having the structure of this embodiment having the lengths L1= approx. 6mm , L3= approx. 10mm and L2= approx. 15mm is durable against the rotational stirring torque of 35-40 kgf.cm without damage or blanching.

<Embodiment 3>

The description will be made as to Embodiment 3. Since the structures other than the stirring rotation member are the same as Embodiment 1, the description will be made as to the shapes of the rotation shaft portion 335a, the supporting arm 335b and the bridging portion 335c of the stirring rotation

member 335.

Figure 13 is a front view of the stirring rotation member 335 (a), a top plan view thereof (b), a side view thereof (c), a top plan view of the horizontal portion 335c2 (d), a side view of the supporting arms 335b2, 335b5 and supporting arm 335b2, 335b5 (e); and Figure 14 is a sectional front view of a toner supply container 301 provided with the stirring rotation member 335.

As shown in Figure 14, the stirring rotation member 335 includes a rotation shaft portion 335a, supporting arms 335b, bridging portions 335c and flexible members 313. The rotation shaft portion 335 a, the supporting arms 335 b and the bridging portion 335 c are produced through injection molding from a plastic resin material having a relatively high rigidity, whereas the flexible member 313 has a relatively low rigidity material (for example, plastic resin material film or sheet, an elastomer sheet or the like). In this embodiment, the flexible member 313 is made of a polyester sheet.

It is preferable that rotation shaft portion 335 a, the supporting arms 335 b and the bridging portion 335 c are preferably produced integrally from a relatively high rigidity plastic resin material through an injection molding, but may be produced by connecting a plurality of parts by welding, bonding or

the like into an integral member. In the embodiment, the use is made with an ABS resin material which is integrally molded through an injection molding.

The description will be made as to the configurations of the rotation shaft portion 335 a, the supporting arm 335 b and the bridging portion 335 c according to one of the features of the present invention.

The rotation shaft portion 335 an and the rotation shaft portion 335 an are each in the form of a rod having a diameter of 9mm, and one end 305d thereof is engageable with the coupling member 306. The other end 335e is engageable with a stopper member (second bearing member) in the second receiving portion 301b2 of the main body 301A of the toner supply container. The coupling member 306 and the stopper member are rotatably supported on the main body 301A of the container through the bearing member 308. Four supporting arms 335b (335b1-335b4) are extended substantially perpendicularly from the rotation shaft portion 335a, and proper roundings are provided at the connecting portions between the rotation shaft portion 335a and the supporting arms 335b to enhance the strength of the stirring rotation member 335. In this embodiment, R2 is provided at each of the connecting portions between the rotation shaft portion 325a and the supporting arms 325b.

The supporting arm 335b and the supporting arm 335b are each in the form of a flat plate and are extended substantially perpendicularly from the rotation shaft portion 335a, and in this embodiment, it has a width 335bL5 (Figure 13) of approx. 12mm and a height of approx. 39.4mm from the axis of the shaft portion 335a. Such supporting arm 33s 5b (335b1-335b4) are provided at six positions, respectively. The thickness 335bL4 (Figure 9) of the supporting arm 335b is preferably 1mm -3mm, and is approx. 2mm in this embodiment. More particularly, two supporting arms 335b1, 335b2 and 335b3, 335b4 are provided to support the opposite end (with respect to the rotation axis)portions of the horizontal portion 335c2. A distance between the center of the rotation shaft portion 335a and the free end of the supporting arm 335b is properly determined in accordance with the size of the main body 301A of the container, but generally it is preferably 70% - 95% of an inner radius of the main body 301A of the container. In this embodiment, the inner diameter of the main body 301A of the container is approx. 44.5mm, and the length is approx. 39.4mm (89%).

The bridging portion 335c and the bridging portion 335c are constituted by two portions and are staggeredly arranged to provide a phase difference of approx. 180^{o} substantially at the central portion with

respect to the axial direction. Total lengths of the bridging portion 33s 5c measured in the axial direction are approx. 180mm, and the bridging portion 33s 5c are spaced apart from the rotation shaft portion 335a by 39.4mm correspondingly to the height of the supporting arms 335b1, 335b2 and 335b3, 335b4. The bridging portion 335c includes a horizontal portion 335c2 extending substantially parallel with a moving direction of the stirring rotation member 335 and an inclined surface portion 335c1 provided downstream of the bridging portion 335c.

The inclined surface portion 335c1 and inclined surface portion 335c1 are provided downstream of the bridging portion 335c with respect to the rotational direction. The inclined surface portion 335c1 is provided with eight projection integral with each of the inclined surface portion 335c1 to securedly support the flexible member 313. The inclined surface portion 335c1 has such a configuration such that width of the inclined surface portion 335c1 at the position where the projections are provided and that at the position where the projections are provided are different from each other, more particularly, the former is larger. In this embodiment, the larger one is approx. 8mm, and the shorter one is approx. 5mm. An angle θ of the inclined surface portion 335c1 relative to the moving

direction of the bridging portion 325c is preferably 30^{o} - 60^{o}, and in this embodiment, $\theta=45^{o}$.

The horizontal portion 335c2 and the horizontal portion 335c2 are provided upstream of the bridging portion 335c with respect to the rotational direction, extending substantially parallel with the moving direction. In this embodiment, the length, measured along the short side, of the neighborhood of the connecting portion of the supporting arm 335b at each of the opposite end portions of the horizontal portion 335c2 is L3 of this invention, and the length measured along the short side of the portion not having the supporting arm 335b. In this embodiment, L1 is approx. 6mm, L3 is approx. 10mm.

The flexible member 313 is similar to that of Embodiment 1, and therefore, the detailed description thereof is omitted for simplicity. A length L2 of free portion of the flexible member 313 from the end of the inclined surface portion 335c1 is 15mm.

Toner discharging test has been carried out with the toner supply container 301 having the above-described structures. The toner discharging test was carried out, 1650g of toner (one component black toner which has positive charging property and which is for GP605 process cartridge available from Canon Kabushiki Kaisha had been filled into the container, and the container had been subjected to a tapping process

using a tapping machine.

The results of the toner discharging test has shown that according to the present invention, the rotational stirring torque required for the stirring rotation at the initial stage is reduced by approx. 20% as compared with a toner supply container not using the present invention, that is, as compared with the container in which the length measured in the tangential direction of the motion of the horizontal portion 305c2 is constant (approx. 10mm) in the longitudinal direction thereof, under the common conditions in which L1=L3= approx. 10mm 2= 15mm at the horizontal portion 305c2 of the bridging portion 305c.

As regards the blade strength, the rotational stirring blade having lengths L1=L3= approx. 10mm and L2= approx. 15mm is durable against the rotational stirring torque of 20-25 kgf.cm without damage or blanching, and the rotational stirring blade having the structure of this embodiment having the lengths L1= approx. 6mm , L3= approx. 10mm and is durable against the rotational stirring torque of 20-25 kgf.cm without damage or blanching.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the

improvements or the scope of the following claims.